

Before the
Federal Communications Commission
Washington, D.C. 20554

In re Application of)
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Motorola Satellite Communications, Inc.) File No. 85-SAT-ML-96
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For modification of license)
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ORDER AND AUTHORIZATION

Adopted: October 30, 1996

Released: October 30 , 1996

By the Chief, International Bureau:

1. Motorola Satellite Communications, Inc. ("MSC") has filed an application for modification of its authorization for the space segment of its proposed "IRIDIUM" low-earth-orbit satellite telecommunication system and an associated request for waiver of certain provisions of the FCC's rules. The application was placed on public notice on March 20, 1996.¹ Hughes Communications Galaxy, Inc. and CellularVision USA, Inc. filed petitions to deny; MSC filed a consolidated response; and CellularVision filed a reply. We grant the application and the waiver requests.

2. MSC is one of three companies² that have obtained permission from the FCC to construct, launch, and operate "Big LEO" Mobile Satellite Service (MSS) satellites -- low-Earth-orbit satellites that commercial licensees would use in conjunction with ground facilities to enable subscribers equipped with mobile transceivers to conduct two-way voice and data communication with similarly-equipped subscribers or telephone users anywhere else in the world. The IRIDIUM System, like other Big LEO systems, would consist of four basic components: a constellation of non-geostationary LEO satellites; end-users' mobile transceivers; ground-based satellite-control facilities; and gateway earth stations. A message

¹ Public Notice, Report No. SPB-40 (released March 20, 1996).

² The other two are LQ Licensee, Inc. and TRW Inc.

transmitted from a subscriber's mobile transceiver would be received by a transiting IRIDIUM satellite and relayed, either directly or via links with other satellites in the IRIDIUM constellation, to a gateway earth station, where it would be analyzed for purposes of routing and billing and would then be relayed via satellite to another mobile terminal or would be directed to a destination on the public switched network. Return messages would follow the same path in reverse.

3. Spectrum in the 1610-1626.5 MHz and 2483.5-2500 MHz bands was internationally allocated for MSS at WRC-92, and the FCC accordingly effected a conforming adjustment of the domestic table of allocations. The Commission subsequently adopted a band-sharing plan for the Big LEO service: spectrum between 1610 and 1621.35 MHz would be assigned for shared use by as many as four Big LEO licensees using CDMA architecture for Earth-to-space service links; the 1621.35-1626.5 MHz band would be assigned to a single Big LEO licensee using TDMA/FDMA architecture, for service links in both directions (Earth-to-space and space-to-Earth); and the 2483.5-2500 MHz band would be reserved for service links in the space-to-Earth direction for CDMA systems.³ (The term "service links" refers to transmissions between satellites and end-users' mobile transceivers.) The Commission did not designate any spectrum for Big LEO *feeder* links, however, because it had not yet determined which frequencies should be allocated for that purpose. (The term "feeder links" refers to the transmission of users' messages in either direction between satellites and gateway earth stations. The Commission has regarded feeder-link transmission as a type of fixed-satellite service.⁴) The Commission noted in this regard that international allocation of spectrum for MSS feeder links was on the agenda for the World Radio Conference to be held in the fall of 1995 and said that it contemplated granting unconditional Big LEO feeder-link assignments once sufficient spectrum had been made available.⁵ The Commission also said that in the interim it would permit qualified applicants to construct satellites capable of operating with particular feeder-link frequencies at the applicants' own risk.

4. In a decision released on January 31, 1995, the FCC granted MSC authority to construct, launch, and operate sixty-six LEO satellites and twelve in-orbit spares capable of operating in the 1621.35-1626.5 MHz range for service links and the 23.18-23.38 GHz range for intersatellite transmissions. As there had not yet been any international or domestic allocation of spectrum for MSS feeder links, however, action was deferred with respect to MSC's request for authority to launch and operate the satellites with a capability of using 19.4-19.6 GHz for satellite-to-gateway transmission and 29.1-29.3 GHz for gateway-to-

³ Amendment of the Commission's Rules to Establish Rules and Policies Pertaining to a Mobile Satellite Service in the 1610-1626.5/2483.5-2500 MHz Frequency Bands, 9 FCC Rcd 5936, ¶¶ 43, 44, and 48 (1994) (Big LEO Report and Order).

⁴ *Id.* at ¶163.

⁵ *Id.* at ¶¶ 166 and 169.

satellite transmission.⁶

5. In the current application, MSC requests "remov[al of] the condition placed on its license with respect to its feederlink spectrum and . . . launch and operational authority with respect to such spectrum." MSC maintains that the time is now ripe for such action because the ITU's recent allocation of spectrum for non-geostationary MSS feeder links at 5091-5250 MHz, 6700-7075 MHz, 15.4-15.7 GHz, 19.3-19.6 GHz, and 29.1-29.4 GHz at the 1995 World Radiocommunications Conference⁷ has eliminated the uncertainty that previously militated against assigning spectrum for Big LEO feeder links.

6. Hughes and CellularVision object to MSC's request for additional operational authority. They contend that the FCC cannot properly grant MSC unconditional authority to use 19.4-19.6 GHz for feeder downlinks prior to resolution of issues under consideration in the Ka-Band⁸ rulemaking in CC Docket No. 92-297, in which the Commission has undertaken to develop a plan for compatible use of spectrum in the 17.7-20.2 GHz and 27.5-30.0 GHz sub-bands by FSS, MSS, and LMDS systems.⁹ In response, MSC asserts that the Commission expressly decided in the Big LEO Report and Order that unconditional feeder-link licenses would be granted once either of two conditions was met, one of which was favorable action at WRC-95 on U.S. proposals for MSS feeder-link allocations, which has since occurred. MSC concedes, however, that it will have to comply with any band-sharing plan adopted in Docket 92-297.

7. Discussion. The Commission adopted a band-sharing plan in the Ka-Band proceeding in a Report and Order released on July 22.¹⁰ As MSC's application comports with that plan, as well as with the corresponding WRC-95 allocation, the pre-conditions specified in the Big LEO Report and Order for granting feeder-link licenses have now been met, and

⁶ *Id.* at ¶18.

⁷ See Final Acts of the World Radiocommunications Conference, Pt. I, at 153, 158, 180, 185, and 190 (Nov. 17, 1995).

⁸ Strictly speaking, it would be more apt to refer to the proceeding as "the K/Ka-Band rulemaking", since it pertains to use of the K Band (18-27 GHz) as well as to use of the Ka Band (27-40 GHz). Our use here of "Ka Band" as shorthand for the combined range of those two adjacent spectrum bands is consistent with prevalent usage in documents referring to that proceeding.

⁹ See Rulemaking to Amend Parts 1, 2, 21, and 25 of the Commission's Rules to Redesignate the 27.5-29.5 GHz Frequency Band, to Reallocate the 29.5-30.0 GHz Frequency Band, to Establish Rules and Policies for Local Multipoint Distribution Service and for Fixed Satellite Services (Third NPRM), 11 FCC Rcd 53 (1995). See also CellularVision, Inc., DA 95-2429 at ¶¶ 22 and 24 (released Dec. 7, 1995).

¹⁰ Rulemaking to Amend Parts 1, 2, 21, and 25 of the Commission's Rules to Redesignate the 27.5-29.5 GHz Frequency Band, to Reallocate the 29.5-30.0 GHz Frequency Band, to Establish Rules and Policies for Local Multipoint Distribution Service and for Fixed Satellite Services, First Report and Order and Fourth Notice of Proposed Rulemaking, FCC No. 96-311 (released July 22, 1996), 61 F.R. 39425 (July 29, 1996), ¶80.

the objections that the application is premature have become moot.

Additional and Enhanced Service Offerings

8. Enhanced ringing and paging services. MSC requests explicit authorization for the IRIDIUM System to provide enhanced ringing and paging services, in addition to the kinds of MSS service that it originally proposed to provide.¹¹ The enhancement would enable users to receive ringing and paging messages during heavier atmospheric fading conditions and in buildings where attenuation is greater, according to MSC. One-way "ring alert" channels at 1626.270833 MHz would be used to alert subscribers with special receive-only mobile earth terminals to the presence of incoming paging calls. Paging messages would be transmitted to the receive-only terminals at 1626.437500, 1626.395833, 1626.145833, or 1626.104167 MHz. Their duration would not exceed 20.32 milliseconds. The transmit power for the ring alert channel would be somewhat higher than the power used for a voice/data channel, so as to enable the mobile earth terminals to receive ring alerts even when their antennas are stowed, but spurious-emission performance would be better than that of the two-way channels on the system when fully loaded. MSC therefore contends that the addition of these services would not increase interference levels or complicate satellite-system coordination. No one else filed comments on this proposal.

9. As it appears that provision of these additional services would enhance the IRIDIUM System's usefulness without increasing interference, we conclude that it would serve the public interest to permit MSC to provide enhanced ringing and paging services as described above, using the specified frequencies, which it may do consistently with the existing terms of its satellite license.

10. Ancillary Fixed-Satellite Services. MSC requests permission to provide incidental and ancillary Fixed-Satellite Services in the 1.6 GHz MSS/RDSS bands. It says that one service of this type that it contemplates providing would involve deploying Mobile Exchange Units ("MXUs") that the proprietors of isolated telephone systems in remote areas could use to establish voice and data links with the IRIDIUM System. Although the units would be transportable, they might be installed as fixtures, in which event, MSC acknowledges, they could be regarded as components of Fixed-Satellite Service. While conceding that there are no international or domestic allocations in the pertinent frequency band for FSS, MSC maintains that Section 2.102 of the FCC's rules and No. 342 of the ITU's International Radio Regulations allow non-conforming use provided that no harmful interference is caused to existing services. It stresses, moreover, that the Commission has approved AMSC's analogous proposal to provide, on an "incidental or ancillary basis," two-way voice and data

¹¹ MSC has previously reported that it intends to provide radiodetermination service, global paging, two-way messaging, data transmission, and two-way digital voice communications. Application of Motorola Satellite Communications, Inc. for IRIDIUM, a Low Earth Orbit Mobile Satellite System, File No. CSS-91-101 at 35-37 (Dec. 1990).

communications to people using portable terminals in fixed installations in remote areas, concluding that implementation of the proposal would promote the public interest by affording service to segments of the population that currently have few alternative means of communication.¹² MSC contends that its proposed deployment of MXUs in remote areas would similarly serve the public interest. It further contends that its proposal is consistent with the Commission's recent proposal to allow CMRS operators to provide fixed wireless local-loop services and other fixed services in spectrum primarily designated for mobile applications, citing Amendment of the Commission's Rules to Permit Flexible Service Offerings in the Commercial Mobile Radio Service.¹³ No one has objected to this request.

11. We will grant the request for permission to provide fixed-satellite services on an ancillary basis, consistently with a general policy of flexibility reflected in precedent,¹⁴ with the usual stipulation that the nonconforming service may only be provided on a no-harmful-interference basis vis-a-vis any licensed service provided in conformance with the Table of Allocations.

Emission Designators

12. The applicant proposes to modify the emission designators for the IRIDIUM System's service links, feeder links, intersatellite links, and control transmissions. It asserts that the change would reflect a design adjustment to take into account doppler shifts in frequency and would not affect compliance with FCC regulations or present any new interference issues.

13. CellularVision USA, Inc., the only party to comment on this proposed change, contends (without explanation) that the proposed change of emission designators for the Ka Band could have a material bearing on co-frequency sharing between MSS and LMDS systems and objects that MSC has not provided a technical analysis to support its no-new-interference assertion. In response, MSC contends that the modification of the Ka Band designators would merely affect channel spacing for multiple carriers within the IRIDIUM System's assigned spectrum range and would have no effect on inter-system parameters.

14. It is true, as the applicant asserts, that the proposed modification would merely narrow the spacing between adjacent channels within its assigned spectrum without increasing interference to terrestrial fixed services. Operation pursuant to the space-to-Earth feeder-link

¹² See AMSC Authorization Order, 4 FCC Rcd 6041, 6048 (1989).

¹³ 11 FCC Rcd 2445 (1996).

¹⁴ See COMSAT and AMSC, 5 FCC Rcd 4117, 4118 ¶8 (1990); AMSC Authorization, 4 FCC Rcd 6041, 6048 ¶51 (1989); Geostar Positioning Corp., 4 FCC Rcd 4538, 4539 (1989); and Qualcomm, Inc., 4 FCC Rcd 1543, 1544 (1989).

authorization that we are granting here could not cause interference to LMDS systems, because the band that we are assigning for MSC's space-to-Earth feeder links, 19.4-19.6 GHz, is far removed from the spectrum allocated for LMDS systems. Nor is there any reason for concern that MSC's space-to-Earth feeder-link transmissions will unduly interfere with terrestrial services operating in the same frequency range, as its power flux density specifications are within the limits prescribed in Section 25.208 of the rules.

15. Insofar as they pertain to the possibility of interference from *Earth-to-space* feeder-link transmission. CellularVision's comments are misdirected; the objection should have been filed in response to U.S. Leo's pending license application for a gateway Earth station for the IRIDIUM System (which we are concurrently granting in another order). We will overlook the procedural irregularity, though, and dispose of the objection here on the merits. We find that the proposed change of emission designators for the IRIDIUM System's feeder uplinks in the assigned band, 29.1-29.25 GHz, will not unduly affect co-frequency LMDS systems. The Commission's recently-adopted spectrum-sharing plan for the upper Ka Band establishes a geographic separation requirement to prevent harmful interference between MSS feeder uplinks and LMDS transmissions,¹⁵ and the proposed change in emission designators is compatible with that provision, which should suffice for relevant purposes of protection. The proposal is also consistent with all other pertinent rule provisions.

16. We therefore grant the request for modification.

Technical Waivers

17. Emissions mask for intersatellite links. MSC has received authority to use 23.18-23.38 GHz for transmission between IRIDIUM satellites. It reports that, because of demanding technical and schedule requirements, the power amplifiers used in the satellites will have operating points set close to saturation and that as a result out-of-band emissions will occasionally exceed the emissions mask specified in Section 25.202(f) of the FCC's rules, to a slight extent. A waiver of 25.202(f) is therefore imperative if the IRIDIUM System is to operate on schedule and perform optimally, according to MSC, which proposes to adhere to a somewhat less restrictive emissions mask.¹⁶ MSC asserts that because the planned inter-satellite transmitters would not point at the ground and would rarely be aligned with non-IRIDIUM satellites, any increased interference to other systems would be negligible even if *no*

¹⁵ See Rulemaking to Amend Parts 1, 2, 21, and 25, First Report and Order, *supra*, n.10.

¹⁶ MSC says in the application that for an emission bandwidth of 25 MHz the emissions in each inter-satellite channel "are expected to meet" the following limit: $PSD(b) = -15 \text{ dB}$ for $12.5 \text{ MHz} < b \leq 37.5 \text{ MHz}$ and -25 dB for $37.5 \text{ MHz} < b$, where $PSD(b)$ = power spectral density at offset frequency b , relative to the PSD measured at the carrier frequency, measured in a 4 kHz or larger bandwidth, and b = frequency of measurement relative to the carrier frequency.

emissions mask were applied. It says that in order to further ensure against causing any out-of-band interference to other systems it would refrain from using the two outer channels in its authorized inter-satellite band on satellites that would exceed the 25.202(f) mask.¹⁷ MSC asserts, moreover, that the proposed adjustment has no material bearing on the results of a recent study by NASA demonstrating that the IRIDIUM System would not interfere with NASA systems or foreign systems, which MSC has previously cited.

18. We grant the request for waiver of 25.202(f) for IRIDIUM's inter-satellite operation, with the following conditions. The waiver is granted only for the frequency sub-band 23.205-23.355 GHz within MSC's assigned bandwidth for intersatellite transmission and only to the levels indicated in its license modification application.¹⁸ Since, as the applicant points out, the main lobes of the IRIDIUM cross-links would not point towards the Earth, there would be substantial discrimination between the system's intersatellite transmissions and terrestrial services operating in bands adjacent to 23.18-23.38 GHz. We are therefore satisfied that emissions produced in adjacent bands from IRIDIUM cross-link transmissions on the six center channels will have negligible impact on those other services. We reserve discretion, however, to require greater attenuation to alleviate harmful interference pursuant to Paragraph (4) of Subsection 25.202(f).

19. Emissions mask for feeder downlinks. MSC also requests a waiver of Section 25.202(f) with respect to feeder-link transmission. It plans to use adaptive power control for feeder-link transmissions from the IRIDIUM satellites, which would tend to suppress interference to other systems. MSC asserts that emissions will be within the limits set by the rule during normal operation but acknowledges that those limits would be exceeded on occasions when the satellites' amplifiers are driven close to saturation while boosting power to maintain adequate performance during periods of heavy rain. Such occasions would be infrequent and of short duration, according to MSC, which estimates that emissions would exceed the 25.202(f) mask only 0.1 percent of the time during transmission to IRIDIUM earth stations in arid locations and only 0.75 percent of the time during transmission to earth stations in "wet" locations, such as Atlanta. It asserts, moreover, that the possibility of increased interference during those infrequent occasions would arise only when an IRIDIUM satellite is close to the boresight of another system's receiving terrestrial antenna and that such intervals of alignment would be very brief; MSC calculates that an IRIDIUM satellite would pass through the 10 dB beamwidth of a typical ground station or terrestrial microwave antenna in about three seconds. Furthermore, MSC stresses that the increased atmospheric attenuation that would trigger a compensatory power-boost would tend to prevent any increase in interference from intermodulation products, in any event. In sum, MSC contends that operation in the power-boost mode as proposed would have negligible interference impact.

¹⁷ As designed, the IRIDIUM satellites would be capable of transmitting and receiving on 8 channels within the 200 MHz spectrum range assigned for inter-satellite links. Thus, limiting operation, as proposed, to the inner six channels would leave 25 MHz guardbands at either end of the assigned spectrum band.

¹⁸ See footnote 16. above.

No party filed comments in opposition to the waiver request.

20. In light of the considerations that the applicant stresses and also in light of the fact that the IRIDIUM satellites must, in any event, operate in compliance with the pertinent p.f.d. limits of Section 25.208(c) of the rules, which the applicant has not asked us to waive, we grant the request for waiver of 25.202(f) with respect to feeder link transmission from IRIDIUM satellites in the assigned 19.4-19.6 GHz sub-band, with the following provisos. Emissions during periods of power-boost must not exceed the predicted levels,¹⁹ and MSC must take all practicable steps to limit spurious emissions outside of its authorized bandwidth to the levels that 25.202(f) permits. This waiver does not signify an intention to relinquish the discretion reserved in Paragraph 25.202(f)(4).²⁰

Construction Milestones

21. The Commission stated in the Big LEO Report and Order that each Big LEO space-station licensee would be required to adhere to a timetable for implementation of its proposal. More specifically, it said that unless an applicant demonstrated a special need for additional time it would be required to begin construction of its first two satellites within one year after receiving an unconditional authorization, to begin construction of the remaining authorized satellites within three years of the same date, to complete construction of the first two within four years, and to put the entire system into operation within six years.²¹ The requirements are to be imposed by specifying the timetables as license conditions.²² To ensure compliance, the Commission adopted rule provisions requiring Big LEO licensees to file annual progress reports and to certify within ten days after each milestone date that the milestone requirement was met or else report that it was missed.²³ We incorporate the milestone timetable detailed in the Big LEO Report and Order in the terms of MSC's license.

¹⁹ MSC represents in the application that for an emission bandwidth of 6.25 MHz it expects emissions during periods of maximum power-boost to peak within this PSD mask: $\text{PSD}(b) = -17 \text{ dB}$ for $3.125 \text{ MHz} < b \leq 6.25 \text{ MHz}$, -27 dB for $6.25 \text{ MHz} < b \leq 15.625 \text{ MHz}$, and -37 dB for $15.625 \text{ MHz} < b$, where $\text{PSD}(b)$ = power spectral density at offset frequency b , relative to the PSD measured at the carrier frequency, both being measured in a 4 kHz or larger bandwidth, and b = frequency of measurement relative to the carrier frequency.

²⁰ Paragraph 25.202(f)(4) provides that when emissions outside of the authorized bandwidth cause harmful interference, the Commission may require attenuation to levels below the limits specified in Subsection 25.202(f).

²¹ 9 FCC Rcd at ¶189.

²² *Id.*

²³ See 47 C.F.R. §25.143(e).

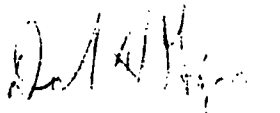
22. Accordingly, pursuant to authority delegated by Section 0.261 of the FCC's rules, 47 C.F.R. §0.261, IT IS ORDERED, that Application No. 85-SAT-ML-96 for modification of license IS GRANTED to the extent indicated herein, in accordance with the technical specifications set forth in the application and consistently with the FCC's rules except insofar as expressly waived herein.

23. IT IS FURTHER ORDERED that, unless extended by the Commission for good cause shown, this authorization will become null and void in the event that the licensee fails to meet the following progress schedule:

	<u>Construction Commenced</u>	<u>Construction Completed</u>	<u>Fully Operational</u>
First two system satellites	October 1997	October 2000	
Remaining system satellites	October 1999		October 2002

24. IT IS FURTHER ORDERED that this license shall not vest in the licensee any right to operate space stations or use the assigned frequencies beyond the term thereof or in any manner other than authorized herein; that neither the license nor the rights granted thereunder shall be assigned or otherwise transferred in violation of the Communications Act; and that the rights granted herein are subject to the rights of use or control conferred by 47 U.S.C. §706.

FEDERAL COMMUNICATIONS COMMISSION

A handwritten signature in dark ink, appearing to read "D. H. Gips", is written over the printed name.

Donald H. Gips
Chief, International Bureau